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Abstract

URANIUM PREPARED BY POWDER METALLURGY TECHNIQUES

M.V. Yakutovich, G.A. Meerson, B.G. Ignatyev, G.P. Kurbatov et al.

Uranium prepared by powder metallurgy techniques and its thermo-mechanical treatment have been investigated for many years in a number of countries.

By controlling the particle size of the initial powder the powder metallurgy method permits to influence both the grain size of the metal in uranium compacted bodies and the number and the character of the oxide inclusion distribution. The latter are introduced in the structure of a dense metal in the form of oxide films on the initial powder particles.

The network of oxide films permeating the structure of dense sintered or hot pressed billets reduces their ductility and strength. The studying of this point is one of the tasks of the present investigation.

The present paper describes the investigations carried out on a metal obtained by hot pressing uranium powder.

Essentially non-porous billets are produced by hot pressing in stainless steel dies.

The high stability of the metal to cyclic changes of temperature results from the fine-grained quasi-isotropic structure of the hot-pressed metal.

The variation in the conditions of the thermomechanical treatment of hot pressed billets results in a change of their structure, eliminates embrittling effect of oxide film inclusions and permits to vary the properties of a dense metal in a wide range.

The tables and figures available show the effect of the amount of the flux ($CaCl_2$) in the charge (UO_2 + Ca) on the uranium powder particle size distribution as well as the powder particle shapes, the metal structure, the

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character of the oxide inclusion distribution and the properties of uranium prepared by the powder metallurgy technique as a function of the thermo-mechanical treatment conditions.

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Abstract

STRUCTURE AND PROPERTIES OF TERNARY ALLOYS CONTAINING THORIUM

T.A.Badaeva, G.K.Alekseenko,
R.I.Kuznetsova

Described are the experimental data obtained by the authors on the structure of ternary alloys containing thorium in the systems thorium-zirconium-titanium, -trorium--zirconium-cerium, thorium-zirconium-molybdenum, thorium-zirconium-niobium. Consideration is given to the study of metastable phases, conditions of their formation and relation to the properties of alloys. Information is provided on the hardness of alloys hardened from the β -hard solution and tempered at 100-600°C.

In the system thorium-zirconium-cerium no wide region of hard ternary solutions based on the body-centered cubic lattice of β -zirconium was observed.

The elements of diagram were plotted for the state of the thorium-zirconium-cerium system in the temperature range from 930°C to the room temperature.

In the thorium-zirconium-molybdenum system a region of ternary $B_{Th-Zr-Mo}$ hard solution on the basis of the body-centered cubic lattice was observed at 1,000°C. A region of the alloys of this solution has been established in which at high temperature hardening, alongside with the body-centered cubic lattice a W-phase resul-

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ting from a partial martensite transformation was observed.

The alloy systems thorium-zirconium-molybdenum and thorium-zirconium-niobium hardened from the region of a hard solution on the basis of a body-centered cubic lattice of β -zirconium were studied to show how the rate of cooling at hardening effects the formation of a W-phase. A decay process of β -phase in these alloys tempered at 100-600°C has also been studied.

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Abstract

BEHAVIOUR OF FUEL UNDER IRRADIATION

V.M.Agronovich, N.F.Pravdyuck

In the paper there are set forth results of theoretical and experimental investigations of some processes arising in fissionable materials. In particular, the theoretical consideration is given of processes being elementary to more complicated process of gas swelling of fuel. Some of these processes are: pore nucleation, pore coagulation, large pore growth owing to small pore dissolving (the coalescence of gas pores). Gas swelling kinetics is studied, considering these elementary processes contribution. There are considered also some features of gas swelling kinetics which may arise in some dispersion systems . The formulas are set forward of engineering swelling calculations for some compositions.

In the paper there are also given results of experimental investigations of stability for some fissionable materials and their consideration basing on modern consumptions.

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Abstract

STUDY OF TENDENCY TO BRITTLENESS OF FERRITE-PEARLITE STEELS FOR REACTOR VESSELS DURING NEUTRON IRRADIATION

A.D.Amayev, P.A.Platonov,
N.F.Pravdyuk et al

The report contains the results of studying the effect of neutron irradiation on the mechanical properties of low-carbon and low-alloy steels and their welded joints used for making power reactor vessels.

The effect of the integrated flux and temperature of irradiation on the tendency to brittleness and the effect of postirradiation annealing on the recovery of steel mechanical properties have been considered. Some regularities are cited showing dependency of steel strength and brittleness on irradiation conditions.

It is proved that steel strengthening caused by neutron irradiation depends not only on the temperature and dose of irradiation but also on steel composition.

The temperature of irradiation is stated to be the main factor determining the stability of properties of the irradiated samples.

The critical temperature of brittleness as measured during shock or static bendings is considered to be one of the basic characteristics for evaluation of safety operation of the reactor vessel material.

Theoretical evaluation of spectrum influence on steel strengthening is given. The product of multiplying numbers with "reduced density" by their effective size is considered to be a criterion of damage.

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Abstract

DEVELOPMENT OF HEAT-RESISTANT FUEL ELEMENTS WITH MAGNESIUM-BERYLLIUM CANNINGS

V.E.Ivanov, V.F.Zelensky et al

It has been established earlier[1] that magnesium-beryllium alloys with a higher against the dissolubility limit, content of beryllium are a promising material for atomic engineering. The report is devoted to the development of industrial methods of magnesium - beryllium alloy production and the study of the alloy properties.

The report discusses the following problems:

1) Development of techniques for the fabrication of magnesium-berillium alloys by powder metallurgy.

2) Structural features of alloys. Resistance to integrating recrystallization. Formation of intermetallic compound $MgBe_{13}$.

3) Strength characteristics of alloys in the range from 20 to 550°C. Specific features of reinforced state. Effect of chemical composition, temperature and rate of deformation on the plasticity of alloys. Margins of alloy plasticity. Kinetics and destructive properties

1) Application of a Mg-Be alloy as a material for gas-cooled reactors. Report by K.D.Sinelnikov, V.E.Ivanov and V.F.Zelensky at the 2nd Conference in 1958.

"High-temperature oxidation of Mg-Be alloys". Report by V.E.Ivanov, V.F.Zelensky, V.K.Khorenko, I.A.Petelgusov and others at the Salzburg Conference on problems of corrosion of reactor materials in 1962.

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of alloys.

4. Corrosion resistance of alloys in air and in commercial carbon dioxide under a pressure of 50 abs. at in the temperature range from 470 to 580°C, the testing time being approximately 14,000 hrs.

5. Resistance of alloys to short-time overheating in air and carbon dioxide media. Effect of chemical composition, condition of the surface and the rate of heating. The burning point of alloys.

6. Applicability of Mg-Be alloys for thin-walled protective jackets of wire-type fuel elements. Hermeticity of jackets and their alignment with cores. Permissible deformation of fuel elements. Effect of irradiation on protective properties of Mg-Be jackets.

7. Advantages of the alloys under consideration over magnesium-based alloys used in nuclear engineering. Prospects for use of the alloys.

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Abstract

RUST-RESISTING PROPERTY OF ZIRCONIUM AND ITS ALLOYS IN WATER AND STEAM AT HIGH TEMPERATURES

V.S.Emeljanov, A.I.Evstjuhin, et al

It is established in this work that the rust-resisting property of zirconium and its alloys is also structural-and-sensitive property. The rust-resisting property greatly depends on distribution and redistribution of ingredients along the boundaries of metal grains and the resulting oxide films. The contact autoradiography and metallography methods reveal that the ingredients of carbon, hydrogen, nitrogen and of some alloying admixtures (tin, iron, nickel and niobium) effect the rust-resisting property of zirconium in water and steam medium of high parameters. Two methods of investigation had been used. In the first case the radiactive isotopes were added to zirconium in the process of founding of alloys. The samples were subjected to heat treatment and then to the rust-resistance test. In this case redistribution of ingredients and alloying elements in the process of corrosion in inactive water and steam of high parameters had been analyzed. In the second case inactive alloys of zirconium in steam and water medium containing tritium had been analyzed. The samples were activated in the process of corrosion as a result of interaction of tritium contained in the water with zirconium.

Electronic microscopic studies were also made of the surface of zirconium and its alloy specimens attacked by corrosion and also of the structures of their cross-sections subjected to cathode pickling.

The results of these investgations are cited in the paper.

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Abstract

EFFECT OF SOME FACTORS ON HYDROGENIZATION AND PROPERTIES OF ZIRCONIUM ALLOYS USED FOR JACKETS OF HEAT-PRODUCING ELEMENTS IN WATER-COOLED POWER REACTORS

N.F.Pravdyuk, S.T.Konobeevsky,
M.L.Orlov et al

The report contains data on the studies carried out with the zirconium jackets of heat-producing elements and various zirconium-alloy specimen tested in experimental water loops of a physical and chemical research reactor. It was established that the degree of hydrogenization and the disposal of hydrides depend on the conditions under which the heat-producing elements operate. It was shown that the nature of disposal of hydrides in the jackets of the heat-producing elements varies with the increase of heat loads. At low heat loads hydrides are orientated along the generatrix, while at high heat loads they are disposed in the main radially. In addition, migration of hydrides towards the cooler side of the jacket was observed.

Effect of stresses on the nature of the disposal of hydrides which are formed due to corrosion in water was studied with the non-radioactive tubular specimen. It was found that with the greater stresses the number of radially disposed hydrides increases and that such a disposal of hydrides results in a sharp reduction of the mechanical strength of the jacket material.

In a physical and chemical research reactor an experi-

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mental assembly of heat-reducing elements with pre-hydrogenized zirconium-alloy jacket was tested. The assembly operated successfully at a heat load of 1.10^6 Cal/m^2 · hr. The results of detailed study of the jackets of the heat-producing elements of this assembly are presented.

The results are also described of the study of the mechanical properties and of the nature of disposal of hydrides in zirconium-alloy specimen pre-hydrogenized to a different degree and exposed to radiation together with this assembly of heat-producing elements. Specimen of the same series exposed to radiation in a "dry" channel were taken as reference ones. It was found that in the specimen exposed to radiation in a non-strained state in water to a temperature of 290°C and known to have a uniform distribution of hydrides, the change of mechanical properties at a flux of 10^{12} n/cm^2 accounted in the main for the radiation. It was proved furthermore that a greater succeptability of the specimen to notching results from pre-hydrogenization. Radiation results in a higher sensitivity of alloys to notching.

Investigations which have been carried out showed that despite some reduction in mechanical properties heat-producing elements with zirconium-niobium alloy jackets can be advantageously used in water-modulated water-cooled reactors.

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Abstract

CORROSION RESISTANCE OF CONSTRUCTION MATERIALS IN ALKALI METALS

B.A. Nevsorov, V.V. Zotov et al.

It is shown in this report that alkali metals (sodium, sodium-potassium alloys, lithium) used as liquid-metal coolants give an opportunity to solve complicated problems of the high-temperature atomic engineering in many aspects.

The possibility of designing the reactors with liquid-metal coolant is defined to a great extent by the profound study of corrosion resistance of the circuit construction materials.

Experimental results of the corrosion resistance tests in alkali metals operated at high temperature are given.

The tests were carried out under static and dynamic conditions.

Investigations of corrosion processes were carried out by different methods.

The plot shows the tendency of some heat-resisting steels and alloys to the mass transfer in the non-isothermal sodium flow.

Experimental data on molybdenum and niobium corrosion as a function of oxygen content in sodium are given.

The experimental results of the carbon transfer mechanism study in sodium are described.

The conclusions are drawn about the influence of different factors on the mechanism of this process.

The data characterizing the peculiarities of corrosion of construction materials in lithium are given.

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Abstract

EXTRACTION PROCESSING OF THE IRRADIATED FUELS BY USING THE SOLUTION OF TRIBUTYLPHOSPHATE IN CARBON TETRACHLORIDE

Pushlenkov M.F., Shumkov V.G.,
Shuvalov O.N et al

The subject of this report is the pilot-plant processing of the solutions of irradiated fuel elements from the power reactors by using 1,1 M TBP solution in CCl_4. The reasons for choice of the flowsheet and the operation order are explained. The flowsheet consists of one circuit for simultaneous extraction of uranium, plutonium and neptunium, two uranium and two plutonium circuits, one neptunium circuit, the processing for aqueous raffinate solutions and the extractant regeneration. While working out the process, much attention was given to recycling solutions. The decontamination factors for fission products limiting the extraction process (Zr,Ru,R.E.) are given by the processing stages.

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Abstract

INTERACTION OF URANIUM WITH ALKALINE METAL FLUORIDES AND RECOVERY OF PLUTONIUM AND SOME FISSION ELEMENTS BY THEM

G.P. Novoselov, I.N. Kascheev, Yu. D. Dogaev and A.T. Ageenkov

Recently extensive studies have been made to determine the applicability of pyrochemical methods to processing irradiated uranium, the method of processing by molten salts draws investigators' attention. Most investigators use non-volatile uranium fluorides (UF_3, UF_4) as a rule, these fluorides are used in the mixture with alkaline earth and alkaline fluorides. On the basis of the thermodyanimic data the latter are usually considered inert diluents of a salt phase. In fact, however, the process is more complicated as it is necessary to take into account the volatility of an alkaline metal which is formed according to the following reaction:

$$M + nRF \rightleftarrows MF_n + nR,$$

where M is uranium, plutonium, etc., R is an alkaline metal.

As the volatility of an alkaline metal is quite appreciable, one can suggest the above reaction to be shifted to the right. Hence, alkaline metal fluorides can interact with U,Pu and most of fission elements. This problem has not yet been discussed from this point of view.

The present paper reports the results of the investigation of the interaction between alkaline metal fluorides and uranium (irradiated and unirradiated) and uranium-plutonium alloys in the wide temperature range (700° - 1300°C). The experiments have been made using resistance and induction furnaces and the inert gas atmosphere. Graphite, Zr carbide, nickel and tantalum crucibles have been employed for melting. The rate of uranium transition into salt has been studied as a function of salt phase composition, time, temperature and intensity of mixing, etc.

It is established that uranium interacts with alkaline metal fluorides

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to form trifluoride at 1250°C or tetrafluoride at 900°C and an alkaline metal.

According to the intensity of interaction, alkaline metal fluorides fall on the line on which the corresponding metals fall according to their volatility.

The study shows that all uranium can be transferred into potassium fluoride melt at 800-1000°C while it is transferred in tiny amounts into a salt mixture $LiF-CaF_2$, when the weight ratio is 1:10 and the temperature is 1250°C. Hence, by changing the salt composition it is possible to conduct the process up to the required limit either by transferring all uranium into salt, or transferring only Pu, some fission elements and partially uranium.

The experiments on the recovery of plutonium from Pu-U alloys into $LiF-CaF_2$ have been made both under static conditions and while mixing. The effect of changing the initial Pu concentration in uranium upon the rate of Pu recovery has been investigated.

It is established that practically all Pu (its residual content in uranium being less than 0.01 mg/g) can be recovered from uranium alloys by molten fluorides. The processing of irradiated U by the mentioned above salts shows that fission elements are recovered by 50-60% and the rare earths are recovered almost completely.

The possibility is examined of the recovery of uranium and other metals from salt concentrates by metal reduction.

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Abstract

EXTRACTION PROCESSES AND THEIR MATHEMATICAL DESCRIPTION

A.M. Rosen, V.G. Yurkin et al.

The present work was undertaken to investigate and quantitatively interpret the regularities of extraction processes: extraction quilibria, material distribution in multi-stage radiochemical extractors, mass-transfer processes.

a. The equilibrium study includes the investigation of the effects of extractant composition and structure, salting-out-agent and diluent influence on the extraction of some actinides by neutral phosphororganic compounds.

An attempt was made to establish the quantitative relationship between the extractability and the solvent structure. The free energy for the extraction of actinides was found to depend approximately linearly on the effective electronegativity sum of functional groups, forming part of the extractant.

The extraction specific feature, i.e. a relatively weak basic chemical interaction between the extracted species and the extractant requires that contribution of both the electrostatic and Vanderwaals' interactions to the chemical potential should be taken into account, i.e. the solution theory should be used. Thus, taking into consideration the electrostatic forces and hydration in terms of electrolyte solution theory, it is possible to interpret theoretically and describe quantitatively the effect of salting-out-agents (it being sufficient to know the ionic diameter and hydration numbers of the compound and salting-out-agent).

The quantitative description of the diluent effect is attained using the theory of multicomponent non-electrolyte solutions. The necessity to consider pair interactions between all the components of the organic phase (dissolvent, extractant, metallic solvate, water, HNO_3) is revealed. The

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interactions are investigated by measurements of the activity coefficients in binary systems. Physicochemical interpretation of the deviations observed from the ideality and their influence on the extraction are given.

b. Extraction cascade regularity study includes techniques for the calculation of material distribution on cascade stage, the determination of recovery and decontamination in the extractors, having different flow-sheets and with combination of an extraction performance and the optimization methods are discussed; it is shown that the influence of change of different parameters (flow, concentration) can be described in terms of a variation of one generalized parameter - the degree of approximation to the limiting condition.

The optimization of the extraction conditions is attained by using criteria which characterize the importance of the decontamination factors, valuable component losses and internal accumulation of elements during reprocessing of different materials.

In conclusion, experimentally determined and computed static and dynamic characteristics of extractors are discussed.

c. Mass-transfer. The general regularities of mass-transfer are changed by the non-ideality of solutions and non-linearity of distribution isotherms (e.g. typical of extraction of actinides by TBP). The inconstancy of distribution coefficients does not permit to eliminate the interface concentrations from the expressions for diffusion flux by a simple procedure; in view of this the typical equation for mass-transfer becomes incorrect. A more general equation is deduced with the regard of the diffusion flux being proportional to the chemical potential gradient rather than to the concentration gradient. Some other possibilities of the elimination of interface concentrations are reviewed; mass-transfer data for extraction of uranium by TBP are interpreted. The discussion is given of some problems of hydrodynamics and mass-transfer from single drops and in the extractors as well as of the criteria facilitating the data correlation. The mechanism of extractor intensification is elucidated.

The effect of the longitudinal mixing and the transverse non-uniformity on the extractor efficiency is considered and the additivity limits of effects are established.

The possibilities of extractor calculation are discussed.

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Abstract

EXTRACTION OF SOME ELEMENTS WITH PHOSPHORUS-CONTAINING MONOBASIC ACIDS

S.M. Karpacheva, M.N. Ryzhov, V.C. Smelov et al.

The paper discusses the extraction mechanism of some elements with acidic phosphorus-containing compounds and gives the results of the investigations of the effect of the structure and the composition of these compounds on their extraction properties.

For the extractants considered the group $>P\overset{O}{\underset{OH}{=}}$ is common in which acidic hydrogen may be substituted by cation, while phosphoryl oxygen takes part in the co-ordination link with an element being extracted.

The cation-exchange mechanism of extracting corresponds to the substitution of hydrogen, while the solvate mechanism corresponds to the co-ordination through phosphoryl oxygen. When the substitution and the co-ordination are simultaneous, a chelate is formed.

Both the mechanisms may be observed when extracting uranium from hydrochloric and nitric acid solutions.

The cation-exchange mechanism prevails at low acidity. In a higher concentration range of mineral acid the degree of the dissociation of the organic extractant is appreciably lowered and the extraction of uranium (VI) is possible by the solvate mechanism which is confirmed by the distribution curves and the infra-red spectra.

Nitric acid is extracted only by the solvate mechanism, while weakly polarized cations Cs, Sr, Ce, Am are extracted by the cation-exchange one only.

The dependency of the extraction power on the structure of the extractant is related to the extraction mechanism. Thus, in extracting uranyl and zirconium nitrates with di-alkyl phosphinic acids and acidic esters of

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methyl phosphinic acid a maximum in the extraction power is observed, that corresponds to a certain number of carbon atoms in an extractant molecule.

The effect of the extractant structure has been studied in more detail by taking the extraction of three valent cations as an example, since only the cation-exchange mechanism of extraction is observed in this case.

The extraction properties of organic compounds were compared using the stability constants of the complexes being extracted at the zero ionic strength.

A study has been made of the dependency of the constant value on the nature of the anion, the length of the alkyl chain in the extractant radical and the introduction of electronegative groups.

The values of constants have been determined for different classes of organic extractants.

A study has also been made of the synergism in extracting uranium (VI) from nitric acid solutions with the binary mixture n-trioctylamine (TOA) - di-iso-amil phosphoric acid (Di-APA). The synergistic effect was found to have a maximum at the certain ratios $\frac{\text{TOA}}{\text{Di.APA}}$ and nitric acid concentrations.

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Abstract

EXTRACTION AND SOME CHEMICAL PROPERTIES OF TRANSPLUTONIUM ELEMENTS

E.S. Gurehev, V.B. Dedov, I.A. Lebedev, G.N. Yakovlev et al.

The transplutonium elements can be produced by the irradiation of heavy isotopes with high integral neutron flux.

To produce these elements for relatively short periods of time the SM-2 reactor with the $2.10^{15} n/cm^2/sec$ flux in the central channel was built in the USSR. There is a large radiochemical laboratory in the reactor building where transplutonium elements including Es and Fm are being extracted and their properties studied. The laboratory is equipped with 16 cells and 56 boxes. In the chambers and in the boxes the experiments with the activity up to 100 000 and I c, respectively, can be carried out. The total effective area of the laboratory is 20 200 m^2. The extraction of transplutonium elements is accomplished by separating them from a great number of fission products and first of all of rare earth elements whose chemical properties are essentially similar.

The extraction properties of these elements with neutral and phosphorous-organic acid compounds from water-salt solutions were studied. The complex formation constants of some transplutonium and rare earth elements with phosphorous organic compounds, mineral acids and a number of other compounds were determined.

Under the static and dynamic conditions the investigations of extractive separation of transplutonium and rare earth elements by phosphor-organic acid compounds and amines from chloride and rhodanide solutions were carried out.

Using these extragents a number of technological schemes of transplutonium element extraction with high yield and practically complete purification of these elements from fission products were obtained.

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Abstract

CHEMICAL AND ELECTROCHEMICAL PROPERTIES OF TECHNETIUM IN WATER SOLUTIONS

A.F. Kusina, N.N. Zamoshnikova et al.

The paper deals with a problem of obtaining pure compounds of technetium from neutron-irradiated molybdenum metal and from the wastes of plutonium production, as well as with a study of chemical and electrochemical properties of technetium.

Technetium can be of a few valencies which easily pass from one to another; sometimes a solution can be even characterized by various states of technetium at a time, all this involves much difficulty when working with this element. Besides, it is necessary to take into consideration such properties of technetium as disproportionation, complex formation and hydrolysis.

Up to this day important problems of technetium chemistry have been those of obtaining its various oxidation states and investigation of their stabilization. Identification and analysis of technetium have involved some difficulties up till now owing to no data on absorption spectra characterizing each of its valent states in various media.

In our earlier investigations we studied an extraction of technetium from acid, alkaline and neutral media by some organic solvents and found that acetone, tributylphosphate and quinoline, which are most available solvents and are able to extract pertechnate-ion with a great distribution coefficient.

Of a special interest is a study of extracting pertechnate-anion by acetone in alkaline medium. Acetone extracts technetium with a high distribution factor (10^4) and allows radiochemically pure technetium to be obtained at the first stage of extracting. Acetone is used by us for obtaining technetium in laboratories.

The paper includes data on chemical and electrochemical properties of

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some of valent states of technetium received by polarography and spectrometry.

A study was made of polarographic recovery of pertechnate-anion by means of a mercury drop electrode against various backgrounds - 1M solutions of KNO_3, KCl, Na_2SO_4, $NaClO_4$, NH_4Cl in a wide range of alkalinity and acidity of solutions as well as in peroxide alkaline and neutral media against the background of KOH and NH_4OH. Diffusion and catalytic processes of electrical reduction of pertechnate-anion in various media were established. Conditions for obtaining different valent states of technetium were found as well as possibility of making use of potential values in analytical chemistry of this element. Stability of oxidation states of technetium VII, VI, IV and metal in alkaline, acid and neutral media were studied.

An investigation of absorption properties of technetium was made with the aid of scarcely soluble precipitates-molybdates, tungstates and phosphates.

A study was made of electrolytic deposition of technetium from sulfurous acid, pH 2, and sulphate-ammonium, pH 5.6, solutions of pertechnate-anion under constant cathode potentials of the platinum electrode used. On the ground of measuring the rates of electrodeposition of technetium the critical potentials of its deposition from these solutions were found. A calculation was also made of a standard potential of technetium oxide which, as to its magnitude, proved to be close to data published in literature.

It was established that electrodeposition of technetium, similar to rhenium, takes place under great overvoltage. Depositions formed on the cathode are not of a clearly crystalline character and their structure can be revealed after additional annealing. X-ray patterns of electrolytic deposits exhibit not only the lines of technetium metal but also the lines whose parameters should be apparently attributed to technetium in oxidation state. They are close to the parameters of the MnO_2 tetragonal lattice.

A presence of colour reactions of technetium with a number of organic substances provided for new methods of its determination by using extraction with the aid of acetone and subsequent photometry.

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Abstract

TECHNOLOGY OF METAL ZIRCONIUM PRODUCTION

A.N.Ogarev et al

The electrolytic preparation of zirconium attracts more and more attention and is considered to be one of the most promising methods of the industrial production of this metal. However, the wide application of this method is restricted because it is not sufficiently studied and because of the unsatisfactory process equipment. In this work an attempt was made to overcome some of these difficulties. In the investigations carried out the emphasis was placed on bringing to light the sources of the contamination of the prepared metal with oxygen as well as on the measures of eliminating these sources.

The sources of the oxygen and nitrogen contamination of the metal prepared in open electrolytic baths and ways of their penetration into the cathode deposit are discovered. The paper reveals the role of the upper part of the cathode deposit, protruding through the electrolyte, and the electrolyte surface, absorbing oxygen from air, in the process of the nitrogen and oxygen contamination of zirconium.

The methods of preventing the contamination of the metal with oxygen and nitrogen are discussed.

The experimental data on the use of hollow cooled cathodes are given.

The data are available, obtained in closed electrolizers.

The main oxygen and nitrogen contamination sources of the metal are discussed.

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The problem of the humidity of calcium chloride and K_2ZrF_6 used as electrolyte components is discussed. The methods of salt drying in vacuum and air at the atmospheric pressure are considered.

The procedure for the determination of oxygen content in K_2ZrF_6 is described.

In the paper the data are also available on the electrolytic refining of zirconium and on the effect of the electrolysis schedule on the degree of refining zirconium from hafnium.

The design of the closed electrolyzer is briefly described.

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Abstract

TECHNOLOGY OF REACTOR COMPONENT FABRICATION OF METAL BERYLLIUM AND ITS OXIDES

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We know a great number of reactors operated, built and designed in which metal beryllium and beryllium oxide are used as moderators and reflectors. In the report the technology of reflector and moderator fabrication of metal beryllium is described as well as that of beryllium oxide reflectors for research reactors.

The material used for reflector and moderator fabrication of metal beryllium is beryllium obtained by the distillation of a technical product. The report contains the description of a plant for beryllium distillation and of the quality of the received metal which is characterized by the impurity content.

The principles of the technology of distillated beryllium milling are stated.

The methods of shaping compact metal-ceramic slabs are described. The technology of cold pressing with subsequent sintering is compared with that of hot pressing in vacuum.

It is pointed out that with the account of beryllium features the fabrication of reflectors and pushers is accomplished by turning, milling, boring, polishing and other kinds of treatment. Several photos characterizing complexity of shapes of single details, reflectors and pushers for research reactors are included.

It is given the description of casting process under the pressure of slips from beryllium oxide on thermoplastic binder. It is stated that for forming of large-sized products with thick walls one should use metal moulds.

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The results of the investigation of conditions for removing of thermoplastic binder out of castings are given. Data showing that the rate of temperature rise after binder removal depends on the amount of the thermoplastic binder are shown.

Techniques and conditions of high temperature sintering of details in a flame furnace are given. A microstructure of a finished product is shown.

The principles of mechanical treatment of beryllium oxide details on flat grinding machine by coherent and free abrasive are stated.